

**PURCHASE SPECIFICATION  
LIGHT EMITTING DIODE (LED) SIGNAL MODULES  
(COMBINATION PEDESTRIAN  
SIGNAL)**

This specification is for the purchase of LED Traffic Signal Modules (herein referred to as modules) in the following configuration: Pedestrian Signal Face (Combination Signal) shall utilize light emitting diode signal modules.

All devices must meet the general specifications of the Transportation Electrical Equipment Specifications (TEES), Chapter 1--General Specifications, as well as the following specification. In case of conflict, this specification shall govern over the TEES, Chapter 1.

## 1 Glossary

Wherever the following terms or abbreviations are used, the intent and meaning shall be interpreted as follows:

AlInGaP	Aluminum Indium Gallium Phosphide Technology and material used in the production of the LED.
Cd	Candela. Unit of luminous intensity measurement.
Chromaticity	The property of color of light
Conflict monitor	Model 210. A device used to prevent conflicting green phases in conjunction with a Model 170 controller. (see TEES)
Controller unit	Model 170 Traffic Signal Controller that is standard equipment on Caltrans maintained signalized intersections. (see TEES)
ITE	Institute of Transportation Engineers
LED	Light Emitting Diode.
Load switch	Series of devices used to switch power to signal indicators
MUTCD	Manual on Uniform Traffic Control Devices
METS	Material Engineering and Testing Services of the Translab.
NEMA	National Electrical Manufacturers Association
Power factor	The ratio of the real power component to the total (complex) power component.
PTCSH	Pedestrian Traffic Control Signal Head
Rated power	The power consumption that the module was designed and tested for, at ambient temperature (25°C or 77°F). See Design Qualification Testing.
TEES	Traffic Electrical Equipment Specifications. A package of standard specifications for traffic electrical equipment to be used on State Highways. This document is prepared by Caltrans Traffic Operations Program.
THD	Total Harmonic Distortion. The amount of higher frequency power on the power line.
Type 1 module	LED module that is designed to be mounted in the place of the existing lens of a traffic signal.
Type 2 module	LED module that is designed to be mounted in the place of the incandescent lamp of a traffic signal utilizing the existing lens and lamp socket.
VTCSH	Vehicle Traffic Control Signal Heads.

## 2 General

- 2.1 Each module shall consist of an assembly that utilizes LEDs as the light source in lieu of an incandescent lamp for use in traffic signal sections.**
- 2.2 The LEDs shall utilize appropriate technology to achieve the required color and shall be the ultra bright type rated for 100,000 hours of continuous operation from 40°C to +74°C.**
- 2.3 The modules shall be rated for a minimum useful life of 48 months. All modules shall meet all parameters of this specification during this period.**
- 2.4 The individual LEDs shall be wired such that a catastrophic loss or the failure of one or more LED will result in the loss of not more than five percent of the signal module light output.**

### 2.5 Electrical

#### 2.5.1 Power Consumption

- 2.5.1.1 Maximum power consumption requirements for the modules are as follows (in Watts):

	25°C	74°C
"Hand"	10.0	12.0
"Walking Person"	9.0	12.0

- 2.5.1.2 LED modules will have EPA Energy Star compliance ratings, if applicable to that shape, size and color.

#### 2.5.2 Operation Voltage

- 2.5.2.1 The modules shall operate from a 60 HZ  $\pm 3$  HZ AC line over a voltage ranging from 95 volts to 135 volts. The fluctuations of line voltage shall have no visible effect on the luminous intensity of the indications.
- 2.5.2.2 Operating voltage of the modules shall be 120 VAC. All parameters shall be measured at this voltage.

#### 2.5.3 Power Factor

The LED signal module shall have a power factor of 0.90 or greater.

#### 2.5.4 THD

Total harmonic distortion (current and voltage) induced into an AC power line by a LED signal module shall not exceed 20 percent.

#### 2.5.5 Surge Suppression

The signal module on-board circuitry shall include voltage surge protection to withstand high-repetition noise transients as stated in Section 2.1.6 of NEMA Standard TS-2, 1992.

- 2.5.6 The LED circuitry shall prevent perceptible flicker to the unaided eye over the voltage range specified above.

- 2.5.7 All wiring and terminal blocks shall meet the requirements of Section 13.02 of the ITE Publication: Equipment and Material Standards, Chapter 2 (Vehicle Traffic Control Signal Heads).

#### 2.5.8 Compatibility

The modules shall be operationally compatible with currently used controller assemblies (solid state load switches, flashers, and conflict monitors). Review TEES Chapters 3 and 6 for specifications on these devices.

- 2.5.8.1 When a current of 20 mA AC (or less) is applied to the unit, the voltage read across the two leads shall be 15 VAC or less.

- 2.5.9 The modules and associated onboard circuitry must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, SubPart B, Section 15 regulations concerning the emission of electronic noise.

### 2.6 Environmental Requirements

- 2.6.1 The LED signal module shall be rated for use in the operating temperature range of 40°C (40°F) to +74°C (+165°F). The modules shall meet all specifications throughout this range.
- 2.6.2 The LED signal module shall be protected against dust and moisture intrusion per the requirements of NEMA Standard 250-1991 for Type 4 enclosures to protect all internal components.

## **2.7 Construction**

- 2.7.1 The LED signal module shall be a single, self-contained device, not requiring onsite assembly for installation into an existing traffic signal housing. The power supply for the module shall be integral to the unit.
- 2.7.2 The circuit board and power supply shall be contained inside the module. Circuit boards shall conform to Chapter 1, Section 6 of the "Transportation Electrical Equipment Specifications".
- 2.7.3 The assembly and manufacturing process for the LED signal assembly shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.

## **2.8 Materials**

- 2.8.1 Material used for the lens and signal module construction shall conform to ASTM specifications for the materials.
- 2.8.2 Enclosures containing either the power supply or electronic components of the signal module shall be made of UL94VO flame retardant materials. The lens of the signal module is excluded from this requirement.

## **2.9 Module Identification**

- 2.9.1 Each module shall have the manufacturer's name, trademark, model number, serial number, date of manufacture (month-year), and lot number as identification permanently marked on the back of the module.
- 2.9.2 The following operating characteristics shall be permanently marked on the back of the module: rated voltage and rated power in Watts and Volt-Ampere.
- 2.9.3 If a specific mounting orientation is required, each module shall have prominent and permanent marking(s) for correct indexing and orientation within a signal housing. The markings shall consist of an up arrow, or the word "UP" or "TOP".

- 3 Type A Pedestrian Signal Face (Combination Raised Hand/Walking Person section)  
The following specifications requirements apply to the Walking Person section only. All general specifications apply unless specifically superseded in this section.

## **3.1 General**

- 3.1.1 Pedestrian signal face modules shall be designed to mount behind or replace the existing face plate of existing Type "A" housing as specified by the requirements in the ITE Publication: Equipment and Material Standards, Chapter 3 (Pedestrian Traffic Control Signal Indications).
- 3.1.2 The design of the modules shall require a specific mounting orientation.

## **3.2 Photometric Requirements**

- 3.2.1 Each module shall provide an average luminous intensity of at least 3,750 candela/m<sup>2</sup> for "Hand" and 5,300 candela/m<sup>2</sup> for "Walking Person" symbol throughout the useful life over the operating temperature range.
- 3.2.2 The uniformity ratio of an illuminated symbol shall not exceed 4 to 1, between the highest luminance area and the lowest luminance area in the module.

- 3.2.3 The color output of the module shall conform to the requirements of Section 5.3 in the ITE Publication: Equipment and Material Standards, Chapter 3 (Pedestrian Traffic Control Signal Indications).

3.2.3.1 "Hand" shall be Portland orange.  
not greater than 0.390, nor less than 0.331, nor less than 0.997 - x

3.2.3.2 Walking person shall be lunar white.  
x: not less than 0.290, nor greater than 0.330  
y: not less than  $1.5x - 0.175$ , nor greater than  $1.5x - 0.130$

### 3.3 Physical and Mechanical Requirements

- 3.3.1 The module shall be designed to be used in the pedestrian signal section as retrofit replacement for existing signal lamps and shall not require special tools for installation.

3.3.1.1 The module shall fit into existing pedestrian signal section housings built to the PTCSH specifications without modification to the housing.

- 3.3.2 The height of each symbol on the module shall be not less than 250 mm and the width of each symbol on the module shall not be less than 165 mm.

### 3.4 Construction

**The modules shall be a single, self-contained device, not requiring on-site assembly for installation into an existing Type "A" housing.**

## 4 Quality Assurance

- 4.1 The modules shall be manufactured in accordance with a manufacturer quality assurance (QA) program. The QA program shall include two types of quality assurance: (1) design quality assurance and (2) production quality assurance. The production quality assurance shall include statistically controlled routine tests to ensure minimum performance levels of LED signal modules built to meet this specification, and a documented process of how problems are to be resolved.**

- 4.2 QA process and test results documentation shall be kept on file for a minimum period of seven years.**

- 4.3 LED signal module designs not satisfying design qualification testing and the production quality assurance testing performance requirements described below shall not be labeled, advertised, or sold as conforming to this specification.**

### 4.4 Design Qualification Testing

- 4.4.1 Design Qualification Testing shall be performed by the manufacturer or an independent testing lab hired by the manufacturer on new LED module designs, and when a major design change has been implemented on an existing design.  
A major design change is defined as a design change (electrical or physical) which changes any of the performance characteristics of the module, results in a different circuit configuration for the power supply, or changes the layout of the individual LED's in the module.

- 4.4.2 A quantity of two units for each design shall be submitted for Design Qualification Testing.

4.4.2.1 Test units shall be submitted to Caltrans Laboratory, Electrical Testing Branch, after the manufacturer's testing is complete.

4.4.2.2 Manufacturer's testing data shall be submitted with test units for Caltrans verification of Design Qualification Testing data.

- 4.4.3 Burn In.

The sample modules shall be energized for a minimum of 24 hours, at 100 percent on-time duty cycle, at a temperature of  $+74^{\circ}\text{C}$  ( $+165^{\circ}\text{F}$ ), before performing any design qualification testing.

- 4.4.4 Any failure of the module, which renders the unit non-compliant with the specification after burn-in, shall be cause for rejection.
- 4.4.5 For Design Qualification Testing, all specifications will be measured including, but not limited to:
- 4.4.5.1 Rated Initial Luminous Intensity, measured over the operating temperature range.
  - 4.4.5.2 Chromaticity (Color), measured over the operating temperature range.
  - 4.4.5.3 Electrical.  
All specified parameters shall be measured and used for quality comparison of production quality assurance on production modules (rated power, etc).
  - 4.4.5.4 Equipment Compatibility.  
Modules shall be tested for compatibility with the controller unit, conflict monitor, and load switch. Each signal module shall be connected to the output of a standard load switch, connected to an AC voltage supply between the values of 95 and 135 VAC, with the input to the load switch in the "off" position. The AC voltage developed across each LED signal module so connected shall not exceed 10 Vrms as the input AC voltage is varied from 95 Vrms to 135 Vrms.
  - 4.4.5.5 Mechanical vibration testing shall be as per MIL-STD-883, Test Method 2007, using 3 four minute cycles along each x, y, and z axis, at a force of 2.5 Gs, with a frequency sweep from 2 HZ to 120 HZ. The loosening of the lens, or of any internal components, or other physical damage shall be cause for rejection.
  - 4.4.5.6 Temperature cycling shall be performed as per MIL-STD-883, Test method 1010. The temperature range shall be per "Environmental Requirements". A minimum of 20 cycles shall be performed with a 30 minute transfer time between temperature extremes and a 30 minute dwell time at each temperature. Module(s) being tested shall be energized and functioning throughout the duration of the test. Failure of a module to function properly or any evidence of cracking of the module lens or housing after temperature cycling shall be cause for rejection.
  - 4.4.5.7 Moisture resistance testing shall be performed on all modules mounted in a standard type "A" pedestrian housing per NEMA Standard 250-1991 for Type 4 enclosures. Any evidence of internal moisture after testing shall be cause for rejection.

#### **4.5 Production Quality Control Testing.**

- 4.5.1 The following Production Quality Assurance tests shall be performed on each new module prior to shipment. Failure to meet requirements of any of these tests shall be cause for rejection. Test results shall be retained by the manufacturer for seven years.
- 4.5.2 Burn-in period shall consist of each signal module being energized at rated voltage for a 30 minute stabilization period before the measurement is made.
- 4.5.3 Each module shall be tested for rated initial intensity after burn-in.
- 4.5.3.1 A single point measurement, with a correlation to the intensity requirements of Section 1.04 of the VTCSH for circular modules, may be used.
  - 4.5.3.2 The ambient temperature for this measurement shall be +25°C (+77°F).
  - 4.5.3.3 Each module not meeting minimum luminous intensity requirements of 3,750 cd/m<sup>2</sup> for Hand and 5300 cd/m<sup>2</sup> for Walking Person Symbol shall be cause for rejection.
- 4.5.4 Each module shall be tested for required power factor after burn-in.
- 4.5.5 Each module shall be measured for current flow in amperes after burn-in. The measured current values shall be compared against rated values resulting from design qualification measurements under "Design Qualification Testing". The current flow shall not exceed the rated value.
- 4.5.6 Each module shall be visually inspected for any exterior physical damage or assembly anomalies. Careful attention shall be paid to the surface of the lens to ensure there are no scratches

(abrasions), cracks, chips, discoloration, or other defects. Any such defect shall be cause for rejection.

#### **4.6 Caltrans Quality Assurance Testing. (random sample testing)**

- 4.6.1 Caltrans may perform random sample testing on all shipments.
- 4.6.2 Random sample testing should be completed within 30 days after delivery to the specified location on the purchase order.
- 4.6.3 Pedestrian module shall be tested according to California Test No. 606 and as described herein.
- 4.6.4 All optical testing shall be performed with the module mounted in a standard traffic signal section or in a standard Type "A" Pedestrian Housing, but without a visor or hood attached to the section or housing.
- 4.6.5 The number of units tested (sample size) shall be determined by the quantity of each model in the shipment. The sample size shall conform to ANSI/ASQC Z1.4. The Caltrans METS shall determine the sampling parameters to be used for the random sample testing.
- 4.6.6 All parameters of the specification may be tested on the shipment sample.
- 4.6.7 Acceptance/Rejection of the shipment shall conform to ANSI/ASQC Z1.4 for random sampled shipments.

#### **5 Warranty**

The manufacturer shall provide a written warranty against defects in materials and workmanship for the modules for a minimum period of 60 months after acceptance of the modules. Replacement modules shall be provided promptly after receipt of modules that have failed at no cost to the State. All warranty documentation shall be given to the TransLab prior to random sample testing.